Photochemical Modeling of Atmospheric Processes of Alternative Transportation Fuels

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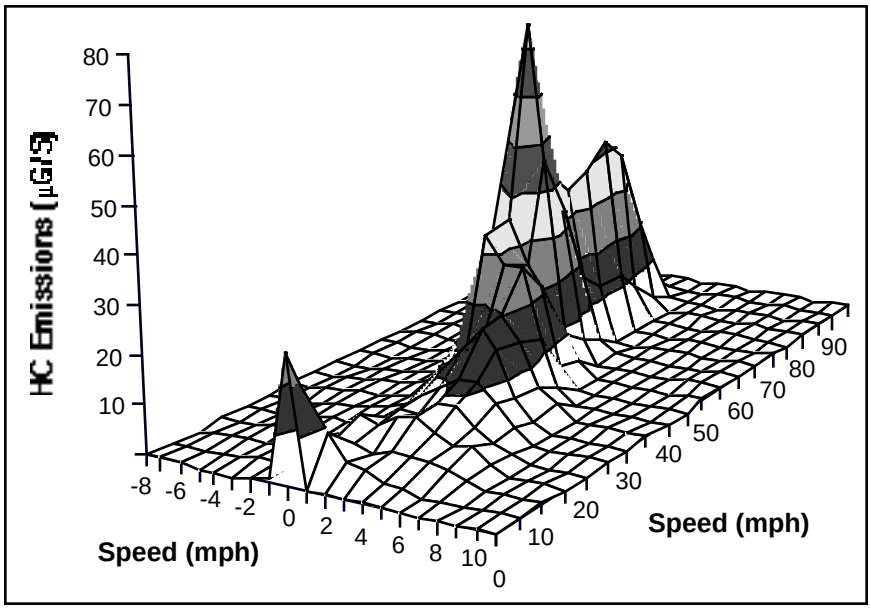
Objective

To evaluate and compare, using photochemical grid models, the potential impacts on air quality of emissions of ozone precursor compounds, toxic air pollutants, and greenhouse gases from alternative on-road motor vehicle transportation fuels. The fuels examined are reformulated gasoline (RFG), low-RVP gasoline (LRG), and compressed natural gas (CNG).



Estimated instantaneous hydrocarbon emissions (micrograms per sec - ond) from light-duty gasoline vehicles in Atlanta. Emission estimates are based on EPA (1995) emission tests in 1994 for 125 late-model vehicles and 1992 driving study data (DeFries and Kishan 1993) for 76 vehicles in Atlanta.

Approach

The Urban Airshed Model (UAM-IV) was used to evaluate the ozone-forming potential of future motor vehicle emission scenarios for two urban areas, Los Angeles and Atlanta. Based on the State Implementation Plan (SIP) modeling episodes established for each urban area, the modeling scenarios are projected forward to 2007. The ozone modeling will be performed using the CBM-IV chemical mechanism to simulate ozone photochemistry.

The RFG and LRG emissions scenarios are the basecase against which the alternative fuel scenario is compared and evaluated. Motor vehicle emissions in the future year for the fuels assume complete penetration in the light- and medium-duty vehicle fleet of the most advanced emissions control technology for which emission measurements are currently available. The emission scenarios also include adjustments to the fuel distribution and mar-

keting emissions to account for penetration of the alternative fuels into the marketplace.

Motor vehicle emissions for each scenario include incremental estimates of emissions caused by vehicle operation outside the speed and engine load boundaries of the current Federal Test Procedure (FTP). The FTP is the standard vehicle driving cycle assumed by EPA in developing the current vehicle emission factor models. By incorporating estimates of incremental emissions that result from off-FTP operation, this study attempts to account for potential underestimation in current estimates of on-road vehicle emissions.

Accomplishments

Vehicle emission adjustment factors for the FTP driving cycle and the off-FTP operations were developed for the fuels. These emission factor estimates were used to develop modeling emission inventories for each of the fuels for Los Angeles and/or Atlanta. These emission inventories were used as input to the UAM-IV model to evaluate the impacts on ozone formation and toxic air pollutant concentrations of each of the alternative fuels. CNG was predicted, in general, to have less adverse impacts on the atmosphere than the basecase fuels

Publications

Moore, G.; Fernan, M.; Balentine, H.; Sedeghi, V.; Dickson, N.; James, E.; Oliver, W.; Killus, J. "Photochemical Modeling of the Atmospheric Processes of Alternative Transportation Fuels." Draft Report to the National Renewable Energy Laboratory Subcontract YCC-5-14072-01. Includes Appendices A-C. July 10, 1996.